Spatio-temporal emergence of mesomorphic patterns in mixtures of rigid rod and liquid crystalline polymers

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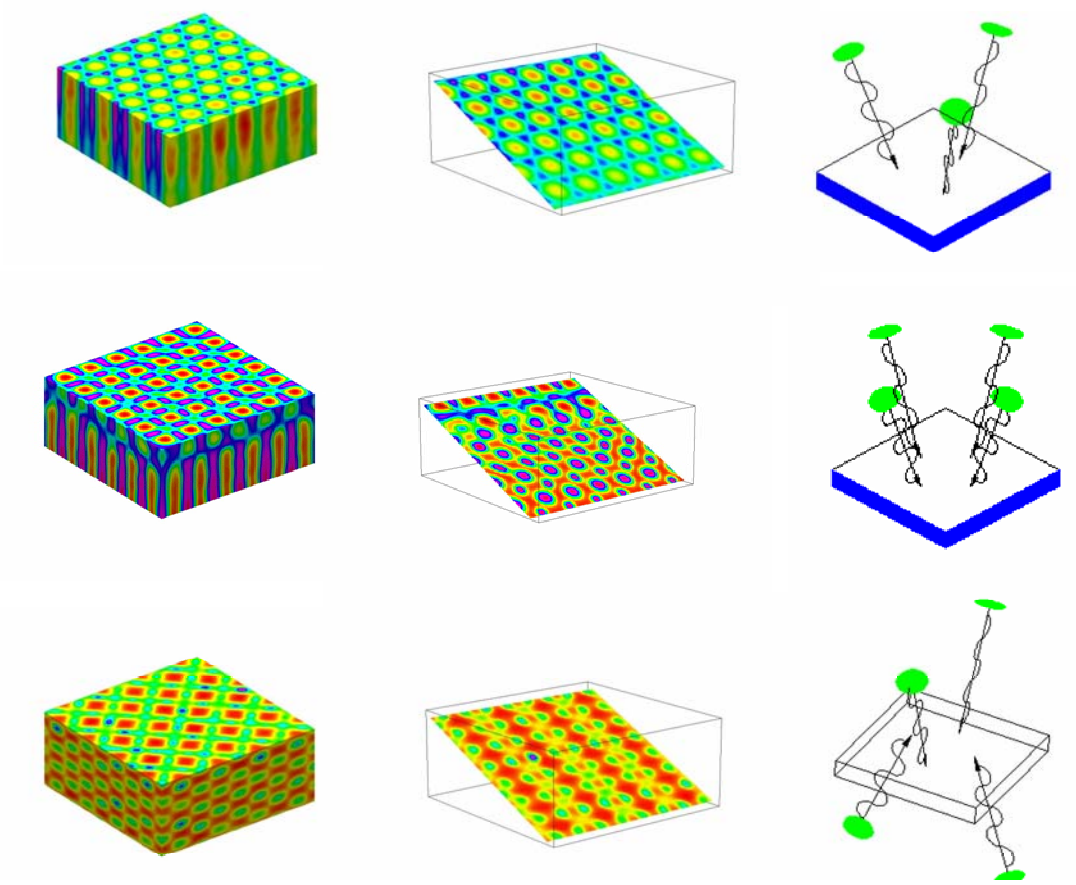

The effect of light attenuation on the formation of holographic polymer dispersed liquid crystals in two and three dimensions has been demonstrated theoretically to guide our experiments. We realized that a similar methodology can be extended to fabrication of photonic crystals. Unlike the passive type inorganic materials based photonics, LC/polymer based photonic crystals are electrically switchable, showing potential for field active applications such as high density data storage and wave guides.

Experimentally, one dimensional H-PDLC has been already accomplished. A new laser with visible to violet wavelength has been already purchased for multiple wave interference experiments.

Holographic polymer dispersed liquid crystals and photonic liquid crystals formed by illumination under multiple interference waves on PDLC containing 50 % LC, showing the effect of light attenuation in diagonal cross-sections under various modes of incident beam geometries. Under the three wave interference geometry, a hexagonal lattice emerges whereas in the optical geometry of four waves from the top a columnar structure is formed. In the case of illuminating 2 waves from the top and 2 waves from the bottom, a body center cubic develops. To generate photonic crystals, it is essential to employ three waves on one side and one from the other which is still underway.

Broader Impact: The pattern forming aspects of mesophase structures in soft matters share a common ground with phase transitions and solidifications of small molecule systems such as ice crystals and metal alloys. The PI has been collaborated with Professor G. Wang of Department of Mechanical Engineering at the University of Akron in the phenomenon of directional crystal growth of low molar mass substance such as succinonitrile. The PI has been collaborating with Prof. D. Reneker of Department of Polymer Science at the University of Akron and also with Dr. A.J. Guenthner of Naval Weapon Research Center of China Lakes, CA, in the area of nanotube pattern formation.

International Collaboration: Under the present grant, the PI has been collaborating with Dr. T. Hashimoto of Kyoto University in the area of phase diagrams and structural evolution of the blends of liquid crystalline polymer/flexible polymers.

The PI has recently started a collaboration with Dr. Leonid Manevitch, Semenov Institute of Chemical Physics, Moscow in the development of faceted hexagonal single crystals from the molecular point of view. Manevitch's group has been focused on the thermodynamic aspects of solidification to seek equilibrium trivial and non-trivial solutions. The PI's group has been directed to solving the space and time evolution of patterns in isothermal and non-isothermal solidification.

Education: The PI is collaborating with Akron Global Polymer Academy (AGPA directed by Dr. Byron Pipes) at the University of Akron to develop remote controlled experimentation of small-angle light scattering as part of the distance learning program.

Four graduate students (Haijun Xu, Greg Yandek, Pratyush Dayal and Rushi Matkar) are involved in this project in 2003-2004. H. Xu graduated with a Ph. D. in May 2004 and now working at the University of Calgary, Canada. Greg Yandek is expected to graduate in coming Fall, 2004.